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ABSTRACT

This course syllabus describes methods for optimizing online searching, using as an example searching on the National Library of Medicine (NLM) online system. Four major activities considered are the online interview, query analysis and search planning, online interaction, and post-search analysis. Within the context of these activities, concepts covered include the basic components of a presearch interview, question negotiation, the communications process, search formulation errors, iterative searching, weighted searching, use of subheadings, efficient telecommunications, and the principles of efficient Elhill processing. The text is supplemented by three figures and bibliographic references/notes, and a 106-item MEDLARS bibliography is provided. Appendixes include lists of MEDLINE tools, NLM serials publications, NLM MeSH and indexing authorities, a glossary, references cited in the appendixes, and a sample search request form. (Author/EW)

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ONLINE SEARCH OPTIMIZATION

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FORWARD

This course was prepared by Michael Homan and Penny Worley under the direction of and with significant input from the Standing Committee for On-Line Retrieval Education, an advisory body to the National Library of Medicine.

ONLINE SEARCH OPTIMIZATION

Course Description

The course is predicated on the fact that an online search involves a series of activities which, when optimized, result in the efficient delivery of a relevant bibliography. The four major activities are: (1) Online interview; (2) Query analysis/search planning; (3) Online interaction; and, (4) Post-search analysis. Within these four major activities the course covers such concepts as the basic components of a presearch interview; question negotiation; the communication process; search formulation errors; iterative searching; weighted searching; use of subheadings; efficient telecommunications; and principles of efficient Elhill processing. The course will explore each of the major activities with the intent of providing specific suggestions aimed at optimizing for cost-effective, system-effective, and end product-effective online searching. Although topics covered are often applicable to any bibliographic retrieval system, the NLM Online System has been chosen as the paradigm for the course, and instruction is geared to those with NLM online search experience. The syllabus has been designed as a reference tool and includes extensive bibliographies and lists of resource material.

ONLINE SEARCH OPTIMIZATION

Agenda

9:00 – 9:15	Registration/Introductions
9:15 – 10:00	Online Interview
10:00 – 10:15	Break
10:15 – 11:15	Interview Practicum
11:15 – 12:00	Query Analysis/Search Planning
12:00 – 1:00	Lunch
1:00 – 2:15	Online Interaction
2:15 – 3:00	Elhill Processing Practicum/Discussion
3:00 – 3:15	Break
3:15 – 3:45	Post Search Analysis
3:45 – 4:15	Self-Evaluation Practicum
4:15 – 4:45	Post-Test
4:45 – 5:00	Discussion

ONLINE SEARCH OPTIMIZATION

Course Objectives

I. Online Interview

1. Discuss the basic components of a pre-search interview.
2. List the important concepts that should be clarified before proceeding with the search formulation.
3. List and describe two types of communication and discuss how they might affect the online interview.
4. List five barriers to the communication process during an online interview.
5. List three techniques for improving the communication process during an online interview.
6. Develop a list of "must ask" questions in response to a practicum involving role playing.

II. Query Analysis/Search Planning

7. Discuss the basic components of the query analysis/search planning phase of an online search.
8. List and describe five categories of common search formulation errors.
9. Discuss the concept of iterative searching in relation to the concept of preformulation.
10. Define 'weighted' searching in the MEDLARS context.
11. Describe an 'exhaustive' search and a 'specific' search.
12. Describe the use of subheadings in the MEDLARS context.

III. Online Interaction

13. Describe the role of telecommunications and telecommunications networks in optimizing online access.
14. List two reasons for transmission noise and slow response time in relation to the telecommunications networks.
15. List and define the major telecommunications system messages.
16. Discuss transmission speed in relation to optimizing the online search.
17. Discuss the Elhill file structure in relation to efficient processing.
18. List the basic principles of efficient Elhill processing and provide examples of each.

IV. Post-Search Analysis

19. Describe the effect of the requester's presence on the iterative search procedure.

20. Discuss arguments for and against the requester's presence during the online interaction and subsequent post-search analysis.
21. Develop a plan including a checklist for searcher self-evaluation.

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ONLINE SEARCH OPTIMIZATION

ONLINE SEARCH OPTIMIZATION

I. Online Interview

"The prime factor [in the success of a search] is the quality of interaction between the requester and the system. Given a request statement that inadequately represents the information requirement, there is nothing that a searcher can do (except purely by chance) to produce a good search result."[1]

This statement is as true today as it was in 1968 when it was used in the now classic MEDLARS evaluation study by F. W. Lancaster. No matter how expert we are with a search formulation or how efficient we are on Elhill, our search will not meet the requester's needs unless we obtain an accurate description. Time spent initially in a pre-search interview is of paramount importance in determining the context and scope of an information need as well as identifying search facets, delimiters and user expectations.

A. Basic Components of a Pre-Search Interview

1. Receive the search request and establish a context for it. User should be asked to complete a search request form.

   Some general considerations:

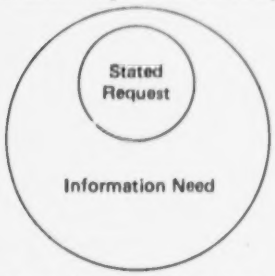
   When the requester writes down his request he is forced to think in narrative form and hopefully choose language which exactly fits his information need. If the requester has not already gone through the discipline of writing down the request, he may have a *less* well-formed idea of the scope and constraints of the search.

   A search analyst may deliberatly record a request in a more general way through pre-conceived notions of how the system might perform. Guard against this.

   An *imprecise need* when discussed with a search analyst in terms of MeSH may become forced into the language and logic of the system and no longer reflect what the requester actually needs.

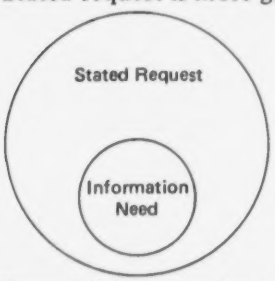
   The following situations can occur when there has been defective or inadequate requester-searcher interaction.

a. Stated request is more specific than the actual information need:



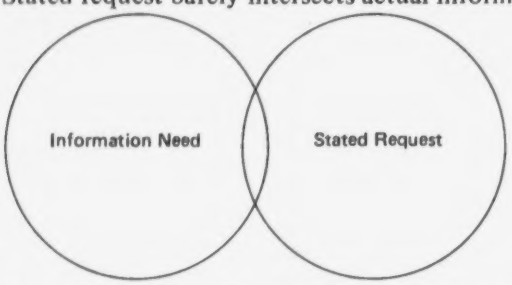
Does this situation lead to a recall or precision error?

b. Stated request is more general than the actual Information need:



Does this situation lead to a recall or precision error?

c. Stated request barely intersects actual information used:



What about recall and precision performance here?

2. Clarify and refine the search request (question negotiation)

Important concepts which should be clarified before proceeding with a search *formulation* include the following:

a. *Purpose of the search.* Knowledge of the purpose of a search is very helpful in precisely defining its scope. The search requirements of a physician who has been asked to write a book or a chapter in a book will be different from a physician who has been asked to give a seminar to a group of nurses. In the former case the requester will probably be prepared to peruse a relatively large number of irrelevant citations in order not to miss any articles of central importance. In the latter case the requester probably wants to see a number of recent major reviews of the entire field (which may not even be his/her specialty). Knowledge of the purpose of a search will also define the limits

that a requester will tolerate if the search needs to be broadened beyond the original request because of low or no retrieval.

b. *Known relevant document.* The list of recent relevant documents will often reveal either that the stated request is too specific or that it is too general. If the relevant citations known to the requester are clearly outside the scope of the stated request, this is an indication that the request statement is too precise. It is also useful to identify authors, institutions, or journals known by the requester to be relevant to the search topic.

c. *Volume of literature.* Occasionally an estimate of the volume of literature will be helpful in determining whether a stated request is too broad or narrow.

d. *What may be excluded.* Some requesters are interested only in clinical studies, others in both human and animal studies, etc. Other delimiters may include language, review, age groups, geography, race, etc.

e. *Recall and Precision requirements.* It is very helpful to know if the requester wants all papers making some reference to his/her topic or whether papers in which the subject matter is treated centrally are required.

f. *Define terminology.* Every field has its own jargon and 'buzz' words. It's very helpful to have the requester define any unknown terminology and provide relevant synonyms. You may want to consult appropriate reference tools with the requester present.

g. *Determine level of knowledge.* It is usually helpful to know whether the person is exploring a new area, is somewhat familar with the area, or has in-depth knowledge of the area.

h. *Determine Retrospective coverage.* Determine what the limitations are regarding the time period to be covered.

B. The Communication Process

Your success in obtaining an accurate description of a requester's information needs will not only be a function of knowing *what* to ask to clarify a request but of your assessment of the requester's mindset or knowledge-state and your communication expertise.

1. *Intra*personal Communication. Before any interactive communication occurs, we all generate expectations as to the outcome of the communication encounter. Mount (1966)[2] suggested the following explanations for ineffective communication based on the knowledge-state of the requester or his/her expectations or perceptions:

   a. Patron lacks knowledge of depth and quality of the collection.
   b. Patron lacks knowledge of reference tools available.

c. Patron lacks knowledge of the vocabulary used by a particular set of tools.
d. Patron does not willingly reveal his/her reason for needing information.
e. Patron has not decided what he/she really wants.
f. Patron is not at ease in asking his/her questions.
g. Patron feels that he/she cannot reveal the true question because it is of a sensitive nature.
h. Patron dislikes the reference staff (or vice versa) and consequently avoids a true picture of his/her needs.
i. Patron lacks confidence in the ability of the reference staff.

Swope and Katzer (1972)[3] examined why requesters failed to ask questions of the reference librarian even though their sample indicated that 41% of the requesters really did have questions. The three major reasons were (1) dissatisfaction with past services of the librarian; (2) the question was perceived as too simple for the librarian; and (3) the user didn't want to bother the librarian.

Horn (1974)[4] contends that there are three reasons for the lack of effective communication: (1) physical difficulties: (2) psychological limitations; and (3) organizational setting.

Other researchers (Cushman and Craig[5]; Wylie[6]; Duval and Wicklund[7]) place self-concept as the most important aspect to all interacting individuals. Two components in this regard are especially important: (1) the individual's evaluation of his/her own role; and (2) the individual's evaluation of the other participants in communication.

As can be seen there is some overlap, but considerable disagreement among those who have studied intrapersonal communication, or the expectations of library staff and library users.

2. *Inter*personal Communication. Interpersonal communication is the face-to-face interaction between the librarian and the requester. Studies that focus on the relationship between the librarian and the requester at the time of interaction (as opposed to direct verbal exchange or face-to-face nonverbal communication) tend to overlap studies of intrapersonal communication. Studies of role perceptions (e.g. Shoshid[8]), power differences (e.g. Smith and Fitt[9]), and ego states (e.g. Braun[10]) suggest along with studies of intrapersonal communication that communication which occurs *internally* (e.g. user expectations, librarian-requester role perceptions) is extremely important to the communication process.

Taylor[11] identified four different communication levels which account for both internal and external information needs. These are:

a. the actual, but unexpressed need for information (the visceral need)
b. the conscious, within-brain description of the need (the conscious need)

c. *the formal statement* of the need (the formalized need)
d. the question as it is presented to the information system (the compromised need)

The formalized need is the level at which a request is normally received in an online interview situation. Taking this formal statement of need at face value may lead to the types of retrieval problems already discussed, because there is often more going on communication-wise than was expressed in the formalized need. How can the online interview be optimized?

C. Optimization of the Online Interview

Success at optimizing the online interview will be a function of (1) knowledge of the retrieval errors that will occur because of ineffective communication; (2) knowledge of the important concepts to be clarified before proceeding with a search formulation; (3) understanding of important concepts underlying interpersonal and intrapersonal communication; (4) effective verbal nonverbal face-to-face communication; and (5) an effective search request form designed to elicit appropriate requester responses.

A few considerations about effective verbal-nonverbal communication:

Gothberg[12] studied both verbal and nonverbal communication in the reference process and found that a requester who was exposed to immediate verbal-nonverbal communication expressed more satisfaction with the reference encounter than a requester who was not exposed to this immediate attention. Other variables which point to success in the reference interview situation identified by Kazlauskas[13] in a kinesic analysis of reference librarians' non-verbal communication include the following.

Positive cues tending to prompt positive nonverbal communication.

1. Eyebrow flash to indicate immediate acknowledgement of requester.
2. Eye contact with requester upon movement of requester into the interview space and a follow-up with positive verbal content.
3. Use of evaluative gestures such as nodding to indicate that the request is being understood.

Negative nonverbal cues:

1. Lack of immediate acknowledgement of a requester wanting to ask a question.
2. No perceptible change of body movement when requester moves into interview space.

3. Staff member sitting with hand held on brow covering the eye vision and engrossed in reading, filing, or other activity.
4. Tapping a finger on the corner of the desk during the time that a request is made.
5. Twitching the mouth or pacing at any time during the reference interviews.

What other observations have you made regarding nonverbal communication?

D. Practicum: Online Search Interview.

The Scene: One of the residents in a large V. A. hospital with several research units drops in to the Library to fill out a search request form which he then gives to you, the reference/online search librarian. You take the search request form from the resident and note that he is interested in the treatment of hypertension with propranolol.

Group Assignment: Using the technique of role playing and your knowledge of techniques for improving the communication process, *develop a list of "must ask" questions* to clarify and refine the residents initial query (treatment of hypertension with propranolol).

Methodology: You will be divided into a number of groups to complete the practicum. Each group will consist of the following "players" who must be selected by group members.

1. A resident
2. An online search analyst
3. A recording secretary/critic
4. A number of observers

The job of the resident will be to respond to questions asked by the online search analyst who is trying to clarify and refine the search request received. The recording secretary/critic is responsible for recording the interaction between the resident and the online search analyst and to suggest additional questions or approaches that might be appropriate to the situation. The observers are expected to "coach" the search analyst and to assist the recording secretary. *Remember:* the end result of the role play should be a list of "must ask" questions that refine and clarify the original query.

Additional information will be supplied to the resident once he/she has been selected by the group.

You will have 30 minutes in which to interview your group's resident and to compile a list of must-ask questions. The recording secretary or another group member should record the list of must-ask questions for presentation to the class.

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ONLINE INTERVIEW – FURTHER READING

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II. Query Analysis/Search Planning

Another critical aspect of the optimized online search is the query analysis/search planning stage. Given a request that has been completely clarified through an online interview so that it perfectly matches the requester's information need, a search can be either completely ruined or substantially reduced in value by an inadequate search forumulation.

The sequence of events which characterizes this phase of the online search process is outlined below:

Query Analysis

1. Identify facets/search parameters
2. Clarify terminology and concepts through

   - standard reference tools
   - past experience
   - past searches Note: Has a bibliography already been prepared?
   - colleagues
   - iterative searching

3. Identify appropriate databases as well as sequence in which databases are to be searched.

   - prioritize
   - use savesearch capability if appropriate

4. Develop online search strategy

   - identify appropriate thesaurus terms
   - identify natural language terms
   - construct search formulation
   - devise a plan for an alternative formulation

Attention should be paid to the following considerations in the query analysis/search planning stage of an online search:

A. Search Formulation Errors. Several categories of search formulation errors are listed below with discussion and/or possible solutions.

   1. Inappropriate terms or term combinations

      Many major descriptors and minor descriptors in MeSH have scope notes which are published once a year and also appear in the Online MeSH file. Use these scope notes and the cross reference structure of MeSH to avoid the use of inappropriate terms.

If a term does not have a scope note, it is undoubtedly defined in one of the many reference authorities used in the construction of MeSH. These include *Dorland's Medical Dictionary, Bergey's Manual, Enzyme Nomenclature,* etc. Appendix [C] lists these various tools. Become familiar with the reference authorities which reflect your search request environment and thus avoid inappropriate terms or term combinations.

A thorough understanding of the structure of the MeSH vocabulary and the classification of the various terms into appropriate subcategories will help avoid using, for example, an "E" term when you really should have used a "B" term. The MeSH term VEHICLES (D26.698.931+) does not refer to transportation, but rather to substances added to a prescription in order to impart a suitable consistency or form to the drug. The fact that the term is not a mode of transportation should be immediately apparent because it is a "D" term rather than a "J" term where automobiles and the like are classified.

Consult with colleagues or other professionals who have expertise in the area in which you have been asked to search.

Consult *Index Medicus* to see if any of the titles listed come close to the stated request.

Consult again with the requester to clarify further if necessary.

2. Defective search logic

   Search errors involving defective search logic generally fall into one of the following three categories:

   a. Dangling "OR"
   b. Use and AND rather than OR
   c. 'ANDing' a term with an explode containing the same term

3. Failure to use one particular relevant term or term combination generally results from not taking into account one or more of the following:

   a. British spelling and American spelling
   b. Plural, singular, adjectival and adverbial forms of words as well as Greek and Latin derivations
   c. Trade names, generic names, chemical names and registry numbers
   d. Failure to use the explode capability where appropriate
   e. Errors in the use of the explode capability
      – Default to 'ALL' in OFFSEARCH
      – multi meaning message
   f. Failure to examine all appropriate tree locations.

4. Failure to cover completely one or more aspects of the search request.

   a. Careless reading/recording
   b. deliberately ignoring the aspect

5. Use of AND NOT logic may cause eventual retrieval/recall problems because the computer programs totally exclude any concept that has been "AND NOTTED." Example: LIVER AND HUMAN versus LIVER AND NOT ANIMAL. Which formulation is preferred most generally and why?

B. Further Considerations for the Planning Stage

1. Iterative searching, that is, modifying a formulation because of something learned online, may be advantageous at the planning stage if the requester has supplied one or more relevant citations that are likely to be in one of the current files. Titles, abstracts and index terms can be checked online and added to the formulation if appropriate, either before you run the search or as the first item of business at the time you run the search.

   Interative searching is useful at the planning stage, but should be considered *mandatory* at the online interaction stage. The great emphasis in interactive bibliographic retrieval systems is on *interaction*. Even if you have checked relevant references for appropriate text words or index terms and have incorporated those found in your search formulation, you should be ready to modify your search formulation because of additional information you learn online through sampling the citations you retrieve.

   Searches can be run in "interactive batch," i.e., no modification of the search formulation because of something learned online, but this is not an optimum use of the online system.

2. Iterative/preformulation tradeoff. There is a tradeoff between total iterative searching (no preformulation) and extensive preformulation with no online modification (the interactive batch situation). Both can lead to search precision or recall failures and other search errors mentioned previously. The fully optimized search combines adequate search planning with online modification as dictated by retrieved citations. The tradeoff point for searchers/institutions will be a function of one or more of the following considerations:

   a. Volume of searching and user-anticipated turnaround time.
   b. Search budget. Can you afford total iterative searching?
   c. Complexity of the database. The more complex the database is, the more preformulation (homework) is generally required.
   d. Number of searchers per online terminal.

3. Weighted searching. MEDLARS provides for two types of weighted searching:

   a. Use of the asterisk in files controlled by MeSH to indicate central or print (Index Medicus) concepts thereby assuring that key concepts in the request are treated centrally in retrieved citations.

Much of the irrelevant material can be eliminated this way and other search concept(s) which would not be asterisked in the search formulation can be broadened to improve recall as much as possible.

The following technique is sometimes used in MeSH files to increase both precision and recall where both search concepts are of equal importance.

SS1 *A AND B
SS2 A AND *B
SS3 1 OR 2

This technique allows the retrieval of citations where one or the other of the facets is a central or print (IM) facet or when both facets are print, thus covering all possibilities.

Note: We are not suggesting that all search formulations should employ weighted searching. We are merely pointing out this unique and powerful MEDLARS capability.

b. Stringsearch of the titles of retrieved citations to assure that key search concepts are contained in the title and therefore are central concepts in the article.

Considerations:

- Not all titles are descriptive of the content of the article. Your search recall may suffer as a result.
- Search recall and precision in this type of weighted searching are dependent on the careful selection of terms likely to appear in the title.

4. Use of subheadings. The use of subheadings can substantially reduce false coordinations and incorrect term relationships in a search. They are used routinely by the indexers to precisely specify a particular aspect of the MeSH heading, and should always be considered in the planning stage.

Further considerations:

- subheadings expressing cause and effect ane co-occurence
- subheadings expressing primary or secondary (new for 1980)
- "floating" or "bald" subheadings/searching on asterisked subheadings.

5. Varying the levels of exhaustivity/specificity

An *exhaustive search* formulation is one in which all search facets/concepts are accounted for in the search formulation (i.e., number of terms required to co-occur before an article is retrieved).

A *specific search* formulation is one in which the generic level of the search terms chosen correspond exactly to the generic level of the search request.

There is no such thing as a "correct" level of exhaustivity or specificity in searching. By varying the levels, we can control the types and numbers of documents that qualify for retrieval and this is an essential part of planning the search strategy.

General points to remember:

a. The tree structures will help identify the generic level to which a term belongs.
b. MEDLARS indexes to the most specific term available in MeSH.
c. General terms are used for very general articles or when no specific term yet exists in MeSH.
d. MEDLARS indexes from many points of view to maximize retrieval points especially for online searching.

Exhaustivity and specificity, continued – Some Pitfalls:

a. Matching the wording of a request with the identical MeSH or free text terms can lead to very poor recall. Compare the formulation for a request for the effects of LSD on the Brain:

   1) LSD AND BRAIN
      versus
   2) LSD and EXP BRAIN

   Both formulations are exhaustive (in that all facets of the search are accounted for) but the latter formulation is the specific search formulation in that the generic level of the request corresponds exactly to the generic level of the search formulation due to the MEDLARS indexing principle of indexing to the most specific level applicable.

b. Can you think of an occasion in which an exhaustive search formulation brings trouble. Compare the following two formulations:

   Search request: "Please provide me with some articles where patients have presented with gunshot wounds of the stomach."

   1) WOUNDS, GUNSHOT AND STOMACH/IN

      versus
   2) WOUNDS, GUNSHOT AND STOMACH/IN AND PATIENTS AND ALL PRESENT: (TW)

Both formulations are specific in that the generic level of the search terms match the generic level of the concepts. The second formulation is certainly the most exhaustive, but what is wrong with it?

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III. Online Interaction

A. Optimizing for Efficient Telecommunications

1. Role of Telecommunications and Telecommunications Networks

The ability to transmit data over the two major national telecommunications networks (Tymnet; Telenet) is the result of advances in communications technology over the past 15 years. The technology used is called "packet switching" and enables the terminals and other components of a computer system to communicate through a network of indirect pathways rather than direct lines from one component to the next. Packets of data are sent separately over various routes to a common destination and computer checked for accuracy all along the route. Microcomputers control the route the data packets will take based on up-to-date data traffic conditions and check for accuracy of transmitted data along the way. Advantages of packet switching technology include the following:

a. Telecommunications networks made possible by this technology obviate the need for long distance calls on expensive pre-allocated telephone lines.
b. Equalizes access for most online centers to bibliographic retrieval systems since communcations nodes are located in most major cities.
c. Checks for accuracy of transmitted data.

Trouble can occur in one system or the other and it is a good idea to familiarize yourself with the login procedure and network messages of both systems as well as direct dial. Table 1 provides a comparison of the two network languages including various error messages.

Some trouble shooting hints to consider are outlined below:

a. *Transmission Noise* – Generally speaking, transmission noise occurs at the user end of the network rather than at the NLM/SUNY end. Data received from the first microprocessor (your local telecommunications node) is verified for accuracy all along the route. If your initial connection to the microprocessor is poor, this may result in transmission noise. Solution: redial the local telecommunications node. Your second (or third) call may result in a better local connection to the microprocessor.
b. *Telephone Instrument* – Some telephones are better than others in transmitting data as opposed to voice transmission. Check with your local telephone company representative for an appropriate instrument.
c. *Slow Response Time* – A slow response time may be the result of a circuitous route mapped out by the telecommunications system at the

Figure 1

TIME-SHARING SYSTEMS – ERROR MESSAGES/TROUBLESHOOTING

NETWORK MESSAGES		MEANING	USER ACTION
TYMNET	TELENET		
ALL PORTS BUSY or HOST OUT OF PORTS	BUSY CONNECTIONS UNAVAILABLE	All telecommunications between the network and the host are busy.	Try again in a few minutes. If this condition persists, notify your computer center.
HOST DOWN	(Address) NOT AVAILABLE (Address) NOT RESPONDING (Address) NOT OPERATING	Host computer is not operating at the moment, although the communication network is fully operational.	Check with your computer center to see when service will be resumed.
HOST SHUT		Traffic is not being permitted at this time although current users are being served.	
CIRCUITS BUSY		Although all systems are operational there are no available lines from TYMNET to the host.	When this message is received, the user should try a different telephone number or wait a few minutes and try the same number again.
HOST NOT AVAILABLE THROUGH NET	(Address) NOT REACHABLE	This message may mean: (1) The node in the particular city is not operating, or	For (1) and (3), try again in a few minutes.
PLEASE TRY AGAIN	ILLEGAL ADDRESS	(2) an invalid host computer has been requested (perhaps mistyped, or	For (2) re-type.
TRY AGAIN		(3) a new Supervisor (the computer which routes users over the network to the host computer) is taking over the network and has not yet picked up that host.	

	ILLEGAL DESTINATION ADDRESS ILLEGAL SOURCE ADDRESS	You are not recognized as an authorized user of the computer system. No connection can be made by TELENET.	
DROPPED BY HOST SYSTEM	DISCONNECTED	The user has logged off and/or has been disconnected by the host computer.	If the session is finished, hang up; if not, try again.
; or HOST IS ONLINE	CONNECTED	Computer connection has been established.	Follow normal log-in procedures.
	(Address) STILL CONNECTED	The terminal is still actively connected to the computer.	If you wish to resume the session, enter the comment CONT to continue.
	(Address) STILL PENDING	Connection is in process.	If you wish to connect to a different computer address, you must type the command D for "disconnect."
	(Address) DOES NOT SUPPORT TERMINAL	Connection is not permitted because of the terminal model or mode.	
HOST NOT RESPONDING		Either the link between the TYCOM and the host is temporarily lost or proper host response to a connect request is not being received.	Try again in a few minutes.
SYSTEM ERROR ON PORT NO. YY		YY is the port number on the TYMCOM to which you are connected. The host system is not responding.	Try again in a few minutes.

moment you dialed into the system. After checking to see if the situation is not a result of heavy NLM/SUNY use (USERS command) you may want to redial the local node hoping for a better connection or switch to another network.

2. Role of Transmission in Search Efficiency

Transmission speed affects search efficiency in the following ways:

Advantages of high speed transmission

1. Increases speed of browsing. Titles of articles, MeSH headings, and abstracts can all be sampled faster at 1200 baud (as opposed to 300 baud or even slower speeds) and therefore shorten the iterative search process.
2. Retrieved citations can be printed at a much faster rate at higher speeds allowing more citations to be printed online.

Disadvantages of high speed transmission

1. Generally higher cost of equipment (lease or purchase)
2. Additional cost for telecommunications modem (for 1200 baud)
3. Less portable equipment to choose from
4. Fewer cities have 1200 baud access.

Question: What rate(s) remain the same no matter what speed terminal you have for searching?

Some basic questions regarding the selection of an appropriate terminal for your particular operation include the following:

1. Is the ability to print most bibliographies entirely online critical to your operation?
2. Are service points located conveniently near your institution for terminals you currently have under consideration?
3. Is portability an important factor in your search operation?
4. Is the print mechanism (thermal; impact, etc.) important?

Please refer to the further readings section of this syllabus for a bibliography on types and speeds of online terminals; advantages and disadvantages of terminals; and, upgrading online equipment.

B. Optimizing for Efficient Elhill Processing

1. Elhill File Structure

A schematic diagram of the general computer configuration and Elhill file structure is depicted in Figures 2 & 3. Much of the efficient processing or

Figure 2

GENERAL COMPUTER CONFIGURATION

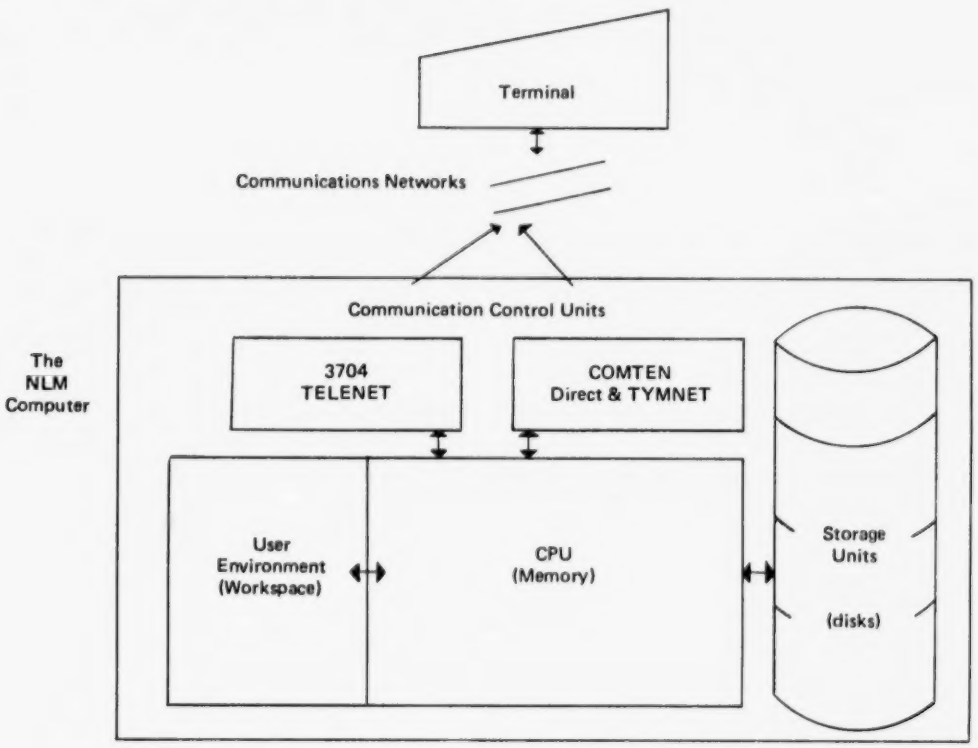
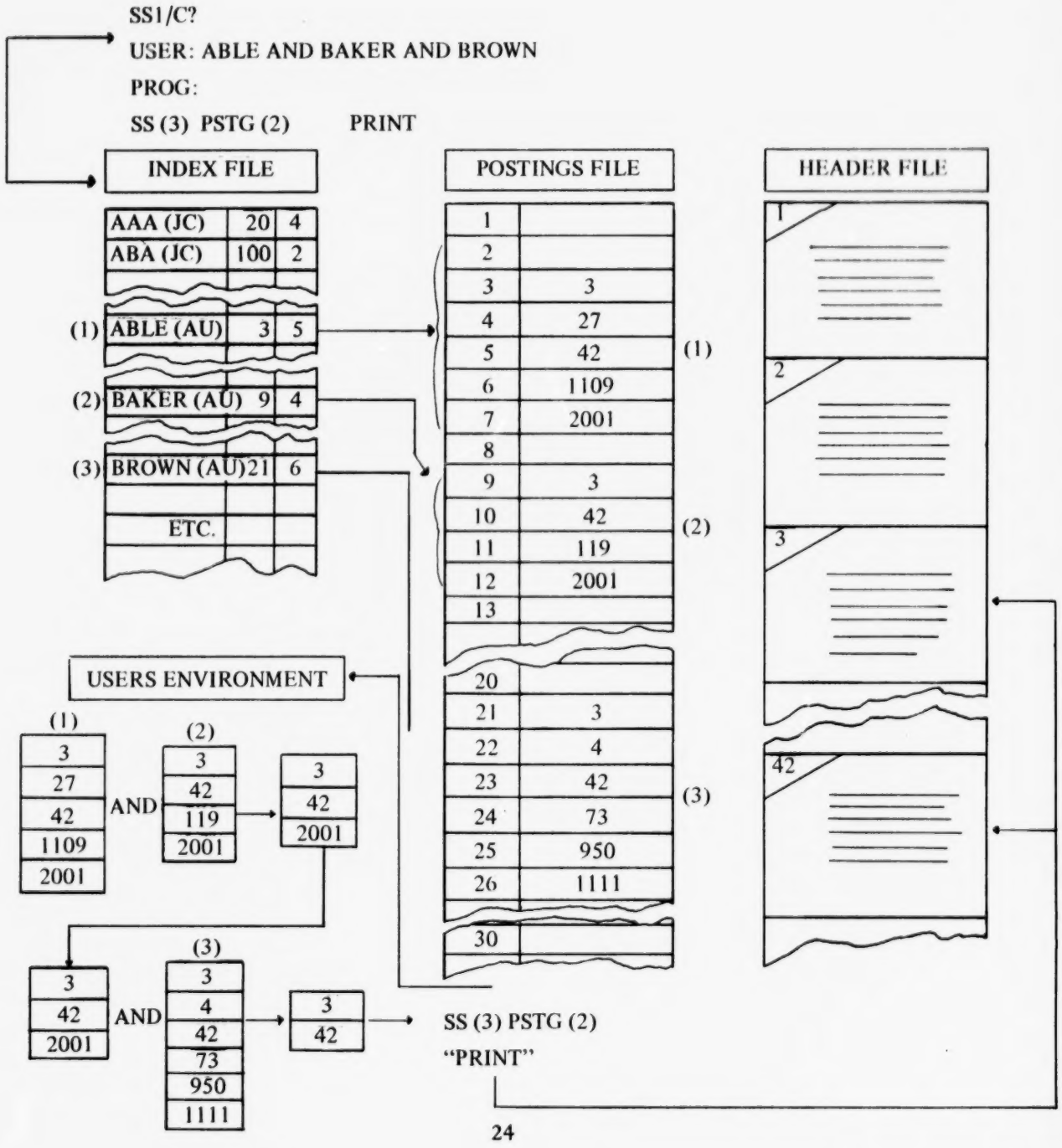


Figure 3

INDEX, POSTINGS, AND HEADER FILES

Search Formulation



inefficient processing on Elhill from a searchers point of view or from a system viewpoint can be related to the Elhill file structure and limitations imposed to support and preserve efficient processing.

Major considerations include the following:

a. File sizes (e.g., index files) reflect the huge size of many of the MEDLARS data bases (e.g., MEDLINE; TOXLINE).
b. Finite work space and disk storage space for each user logged into the system is a necessity. Overflow messages result when too much work space is used.
c. Time-slicing needed for operational efficiency. (highly posted terms and stringsearch)

2. The basic principles of efficient Elhill processing include the following:

   a. *System Overflow Situations* – Time overflow and continue processing messages all reduce overall search efficiency. The Elhill principles listed below related to these messages.

      1) Do not make redundant use of the index file (e.g., repeated use of single terms, explodes or truncations).
      2) Do not build up enormous postings for further processing.
      3) Always keep intermediate search results as small as possible.

   b. *Stringsearch* – Stringsearch is designed to allow the searcher using the Elhill software to achieve word adjacency; retrieve terms not posted to the Index File; and, to avoid time overflow messages with certain highly posted terms in the system. Principles of efficient use of the stringsearch capability include the following:

      4) A direct search on the index file for a highly posted term (e.g., HUMAN) is LESS efficine than a stringsearch for the same term when the number of TIMEOVFL messages resulting from the direct search exceeds the number of CONT. PROCESSING messages for the stringsearch.
      5) AVOID stringsearching when a textword search can get the same answer.
      6) AVOID stringsearching without reducing the search statement by use TW's or appropriate MH coordinations.
      7) For *System* efficiency, *avoid* stringsearching in OFFSEARCH to restrict a search to highly posted terms, check tags and languages such as HUMAN, ENG. ENGLISH ABSTRACT, etc. When in OFFSEARCH these terms should be searched directly on the Index File, not stringsearched.

c. *Explosions/Multiple Search Statements* –

8) Consider: one explosion per search statement if the explosions are large.
9) Single search statements with multiple terms are more efficient than single terms in multiple search statements.

d) *Automatic Processing* –

10) Let the system do your work for you. (e.g., automatic SDI's; STORAD, SAVESEARCH, etc.)

e) *Prespecification/Qualification* – prespecification (inputting the answer to a program query before it is asked) and qualification (specifying the type of term to be retrieved – MH, TA, etc.) both result in search efficiency according to the following principles:

11) Qualified search terms will often result in a shorter search session. (e.g., avoids MM messages -- a necessity in TDB)
12) Use prespecification whenever possible to increase search efficiency by decreasing searcher "wait time" for a system response.

f. *General Principle*

13) Search at non-peak hours (e.g., non-prime time) and don't forget to use SUNY when appropriate.

C. Optimizing the Iterative Search Process

The concept of iterating searching introduced previously in the query analysis section of this syllabus becomes of paramount importance during the on-line interaction phase. The sampling of relevant and/or non-relevant citations and reformulating as necessary to obtain the desired end result is a process known as iterative searching. It is a heuristic process in that it is a type of problem solving in which solutions are discovered by evaluation of the progress made toward the final result. Bates[1] suggested the following "monitoring tactics" to keep the search on track and efficient:

1. Check – Review the original request and compare it to the current search topic to see that it is the same.
2. Weight – Make a cost-benefit assessment, at one or more points of the search, of current or anticipated actions.
3. Pattern – To make oneself aware of a search pattern, examine it, and redesign it if no longer appropriate, efficient, or out of date.

4. Correct – Watch out for and correct factual and spelling errors in the search topic.
5. Record – Keep track of trails one has followed and of desirable trails not followed up or not completed.

Be flexible, creative, and open to new approaches as you sample retrieved citations. The iterative search process is the heart of the online search and that which distinguishes it from a non-interactive batch search. When search redesign is called for on the basis of information gleaned from retrieved citations, Bates[1] suggests the following search formulation (or reformulation) tactics.

1. Specify – Search on terms that are as specific as the information desired.
2. Exhaust – Include most or all search elements of the request in the initial formulation or *add* one or more of the search elements to an already prepared formulation.
3. Reduce – Minimize the number of elements of the search request in the initial formulation or *substract* one or more of the search elements from an already prepared formulation.
4. Parallel – Make the formulation broader by including synonyms or other parallel terms.
5. Pinpoint – Make the formulation precise by minimizing or reducing the number of synonymous or like terms, retaining only the most descriptive terms.
6. Block – Reject items in the search formulation even if it means that you don't retrieve some relevant documents.

ELHILL PRACTICUM

Directions: On an individual basis, or working in small groups construct alternate search strategies which are more efficient than those which have been provided. Use the right hand column for your alternate strategies. *Explain why your strategy is more efficient in each case.* You are restricted to the vocabulary used in the strategy provided.

1. Learning Disabilities in Children SS1/C? Exp LEARNING DISABILITIES SS2/C? CHILD OR CHILD, PRESCHOOL OR ADOLESCENCE SS3/C? 1 AND 2	
2. Neoplastic immunotherapy and immunologic technics. SS1/C? NEOPLASMS (PX) AND IMMUNOTHERAPY SS2/C NEOPLASMS (PX) AND IMMUNOLOGIC TECHNICS SS3/C 1 OR 2	
3. Cyclophosphamide Cardiotoxicity SS1/C? CYCLOPHOSPHAMIDE SS2/C? TS(TI) :CARDIOTOX: OR :CARDIOTOX: (AB)	

4. Pregnadienes and endometriosis. English only. 1966-1969 OFFSEARCH *STS* SS1/C? USER: EXP PREGNADIENES AND ENDOMETRIOSIS *STS* SS2/C? USER: TS (LA) ENG	
5. Effects of Velsicol 506 on the nervous system. SS1/C? EXP NERVOUS SYSTEM SS2?C? TS(TI) :VELSICOL 506: OR :VELSICOL 506: (AB)	
6. Tumor Associated Renal Failure. Will accept English articles or foreign articles with English abstracts. SS1/C? ALL KIDNEY FAILURE: [250 CITATIONS RETRIEVED] SS2/C? 1 AND NEOPLASMS (PX) SS3/C? 2 AND ENG (LA) SS4/C? 2 AND ENGLISH ABSTRACT SS5/C? 3 OR 4	

7. Articles or editorials in the New England Journal of Medicine on the Patient Package Insert published in 1979 and 1978. SS1/C? PACKAGE INSERT AND PATIENTS (50 citations retrieved) SS2/C? 1 AND N ENGL J MED (TA) [15 citations retrieved] SS3/C? TS (YR) :79: OR :78: What's wrong with this this search?	
8. LD50's for Minoxidil in rats, cats, and monkeys. SS1/C? LETHAL DOSE 50 AND MINOXIDIL SS2/C? RATS SS3/C? CATS SS4/C? MONKEYS SS5/C? 1 AND 2 OR 1 AND 3 OR 1 AND 4	

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IV. Post-Search Analysis

The last stage of the search process is the post-search analysis in which the searcher, the requester, or both review the citations retrieved.

A. Requester is present during the online interaction. Major considerations:

If the requester is present during the online interaction he/she on seeing a sample of retrieved citations may be prompted to be more precise and thereby to exclude certain categories of materials that he/she did not think to exclude originally.

The requester's reactions and comments regarding retrieved citations will verify the distance between the stated request and the actual information need and thus greatly assist the iterative search procedure.

The typical requester upon seeing a sample of retrieved citations will be aware that certain of the citations are of no value, but unless he/she is completely current with the published literature there will be little or no comprehension of what the search has missed – (unless of course, relevant citations known to the requester and in the current data base are not retrieved).

If the requester has a good overall knowledge of the literature, the search may have been requested:

1. To assure the requester that articles of central importance have not been overlooked.
2. To bring to the requester's attention for the first time certain articles of peripheral relevance.

Arguments against the requester being present during the online interaction and post-search analysis stage:

1. Scheduling difficulties because of physical location of the information center.
2. Scheduling difficulties because of demand for the online terminal by several searchers.
3. Not cost-effective – too time consuming from the point of view of online connect time and online searcher-requester interaction time.
4. Not necessary if there has been an adequate online interview.

B. Requester is not present during the online interaction. Major considerations:

Review of the printout will be dependent on the search analyst's expertise or organizational guidelines.

Will you edit the search results to eliminate irrelevant citations or let the requester browse through the entire bibliography?

Will you send a questionnaire along with the retrieved citations to solicit feedback on the usefulness/relevancy of the search?

C. Quality Control/Practicum

The post-search analysis of citations and follow-up with the requester regarding the usefulness/relevancy of the search is only a part of the complete picture. Of equal importance (if not more important) to the institution for which you do literature searching is the consistency of approach to searching, or quality control of online searching.

Quality control from an institutional viewpoint might be expressed in the following ways:

1. Insistence on formal training from an outside agency (e.g., NLM); or, a formal inhouse training class.
2. Regular attendance at online update sessions or other continuing education courses.
3. Apprenticeship to an experienced searcher for a specified period of time.
4. Regular review by supervision of online searches run at the institution (Sampling method).

Perhaps your institution's quality control program involves all of the above. Even if there is no institutional quality control program, there is another type of quality control which is searcher *self-evaluation.* Through self-evaluation of our performance, we have a built-in monitoring system for quality control of online searching.

As an exercise to get you thinking along the lines of quality control you will be divided into a number of groups to develop a quality control checklist. For the purposes of the exercise think of yourselves as supervisors of a literature search operation who have a number of neophyte searchers apprenticed to you. The neophytes have completed an NLM training course and have just returned from a Regional Medical Library sponsored online update. You will be reviewing searches with each neophyte on a regular basis for the next several weeks. Develop a checklist for this purpose.

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APPENDICES

MEDLINE TOOLS

Accession No.	Publication Title	Price
PB-300-500	Medical Subject Headings Annotated Alphabetic List, 1980.	15.00
PB-300-498	Medical Subject Headings – Tree Structures, 1980.	10.50
PB80-104706	Medical Subject Headings – Tree Annotations, 1980. (for each tree general searching hints are given, and special features and specific indexing idiosyncracies intended to complement the notes found in Medical Subject Headings, Annotated Alphabetic List)	7.25
PB-245-412	Technical Notes: MEDLARS Indexing Instructions: Supplements I-IV, 1975 (blood groups, blood proteins, enzyme deficiencies, Tumor Keys)	8.00
PB-263-335	Technical Notes: MEDLARS Indexing Instructions: Supplements V-VI (Enzyme Key and Fungus Key	4.50
PB80-114531	NLM On-Line Services Reference Manual, 1980. (NLM issues 1 complimentary copy to all new NLM Online centers)	10.50
PB-254-270	MEDLARS Indexing Manual (Part I) Bibliographic Principles and Descriptive Indexing, 1977. (gives indexing policies of NLM for descriptive indexing – Part II, subject indexing)	7.25
PB-271-306	MEDLARS Indexing Manual (Part II), 1977 (subject indexing)	14.00
PB-241-734	Technical Notes – MEDLARS Indexing Instructions (Authority on indexing practices after MeSH and the Indexing Manual. Referred to in Annotated MeSH by designation TN and a number)	6.50
PB-300-499	Permuted Medical Subject Headings, 1980. (permutes the phrases and inverted terms in MeSH)	9.00
PB-271-252	Scope and Coverage Manual of the National Library of Medicine (designed to guide NLM staff in selecting literature for the Library's collection) – (1977)	5.25
PB-219-054	Cumulated List of New Medical Subject Headings, 1963-1973 (useful in determining history of medical subject headings)	11.00

Ordering Information

The publications listed above are available from NTIS at the following address: National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. When ordering, please include both title and accession number, as well as the superseded accession number if applicable. A check or money order payable to NTIS should be sent with the order.

Appendix B

NLM SERIAL PUBLICATIONS

1. *The NLM Technical Bulletin.* (Monthly to Network subscribers)
2. *National Library of Medicine Programs and Services.* (Annual)
3. *National Library of Medicine News.* (Monthly)
4. *TOX-TIPS* (Toxicology Information Program)
5. *Toxicology Research Projects Directory*

NLM MESH AND INDEXING AUTHORITIES

GENERAL

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Appendix D

GLOSSARY

The following list of terms and definitions is a combination of computer terms, computer search terms, and computer networking terms. More comprehensive glossaries are available on computer terms from Data Phase Systems, Inc.[1] and on networking terminology compiled by Neuman[2] in *Information Reports and Bibliographies.*

ALGORITHM: A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

CONNECT TIME: The measure of system usage by a user, generally the time interval that the terminal was online.

CPU: Central processing unit, the part of the computer which actually performs most of the computations.

CPU TIME: Excluding I/O (Input/Output), time the computer takes to evaluate a request. It may be thought of as calculation time or "think time."

DATA BASE: As entire collection of files maintained in the computer system.

DATA SET: A term synonymous with MODEM.

DISK ACCESSES (I/O TIME): The computer stores, on disk, lists of citation numbers for each term that may be used for searching. The higher the postings for a term, the more disk accesses (i.e., the more times the computer has to find the list and "read" it) are required to process the term. Once the list has been "read," the computer must then "write" the results into one of its storage areas. I/O time, therefore, is the time spent reading the lists and writing the results.

DISK PACK: A device containing several individual platters, each of which has hundreds of tracks of information. The tracks are subdivided into several dozen sectors. It is these sectors that are accessed when writing or reading information.

ECHO CHECK: A method of checking the accuracy of transmission of data in which the received data are returned to the sending end for comparison with the original data. Full duplex operation employs an echo check.

FALSE COORDINATION: The retrieval of an unwanted reference(s) due to indexing limitations and/or incorrect term relationships. Synonyms: False drop; Noise.

FIELD: That specific area of a stored record used for a particular category of data such as author, title, source, abstract, etc.

FIXED-LENGTH RECORD: A record that has the length fixed in advance rather than being varied according to the actual extent of the contents, e.g., the Language field in MEDLINE (fixed) versus the abstract field (variable).

FULL DUPLEX: A mode of transmission of data in which data may be transmitted simultaneously in both directions over two channels. One of the channels is equipped for transmission in one direction while the other is equipped for transmission in the opposite direction. Synonyms: Duplex; two-way simultaneous operation.

HALF DUPLEX: A mode of transmission in which data may be transmitted in both directions, one way at a time. Synonyms: two-way alternate operation; Either way operation.

HARD COPY: A printed copy of computer output as opposed to a temporary display on a screen.

HARDWARE: The components of a computer system, including the central processor, disks, terminals, etc., as distinguished from the software or programs that operate the system.

HEURISTIC: Problem solving in which solutions are discovered by evaluation of the progress made toward the final result.

HOST COMPUTER: The controlling or principal computer in a system that links two or more computers together.

INTERMEDIATE RESULTS: The lists of citation numbers which the computer must generate and save for further processing while in the process of building a final "answer" to a search statement. For example, in the search A AND B OR C AND D, the computer first processes the lists of citation numbers for A and B. The results of this step are the *intermediate* results. Then, the process is repeated for lists C and D. A final comparison of the two intermediate results produces the "answer." Intermediate results are created because the computer can only compare two lists at a time.

MODEM: A device that translates computer signals into signal compatible with telecommunications facilities.

NANOSECOND: One-thousand-millionth of a second.

NODE: Generally thought of as a communications computer or a communications computer installation in a computer network.

OPERATING SYSTEM: Software that controls the execution of computer programs. Synonyms: Supervisor; Executive; Monitor; Master Control Program.

OVERFLOW: The condition raised while processing a search request indicating to the user that he has run out of a particular space allocated to him. There are five kinds of overflow: Time overflow; postings storage overlow; postings process overflow; keybord terms overflow; generated terms overflow.

a. TIME OVFL: CONT? – This message informs the user that the last search statement input requires more than one "slice" of time to process. After each "slice" of processing time, the program inquires as to whether or not the user wishes to continue the processing.
b. STORPSTG OVFL – The limit for postings stored in the user's workspace, 114,000 has been exceeded.
c. PROCPSTG OVFL – This is a postings processor overflow message, meaning that the total postings retrieved by the search statement exceed the storage capacity of the program (160,000 records). This often happens when intermediate results (see above) awaiting final processing are large.
d. KEBTRM OVFL – Means that more than 380 search terms have been entered, (keyed in) during current search session. Explosions are considered one term. This message rarely occurs.
e. GENTERM OVFL – This is a generated term overflow, indicating that more than 450 terms have been generated in a given search statement. Happens most often with truncated root words (e.g., ALL RAT:) or a series of OR'd explosions.

PORT: The part of the central processing unit which provides a channel for receiving and sending data from or to a remote device such as a computer terminal.

PRECISION: The relevant references retrieved as compared to the total retrieval. Generally expressed as a ratio of *relevant* references retrieved to total references retrieved.

RECALL: The percentage of relevant references retrieved as compared to the total known relevant documents. Generally expressed as a ratio of relevant documents retrieved to total known relevant documents.

RESPONSE TIME: The total time period from the pressing of the carriage return key on the terminal to the receipt of the first character of the response. It consists of the following:

a. Transmission along the communications network of computers to the NLM/SUNY computers.
b. Processing the message by a computer program which converts the codes to computer processing code and the placing of the message in a queue behind other users' messages to await processing by the retrieval program (ELHILL).
c. Processing of the message by ELHILL and sending the output message to the program mentioned in b, above.
d. The front-end program now converts the messages to the code and starts the transmission to the communication system (Tymshare; Telenet).

e. The communication system routes the messages to the appropriate terminal where it is finally printed.

SEARCH TERM: The data in a search request separated by the boolean operators (AND, OR, AND NOT). Thus the request HEART AND LUNG DISEASES contains two search terms (HEART, LUNG DISEASES). Also HEART AND EXPLODE C8.381 (Lung Diseases) contains two terms (HEART, EXPLODE C8.381). The reader should be aware that an EXPLODE while only considered as one term is actually the ORing of many terms so that in terms of *WORK* for the computer HEART AND EXPLODE C8.383 is actually fifty terms. A numbered search statement, used in a subsequent one, is also considered to be a search term.

SOFTWARE: The set of programs, procedures and documentation concerned with the operation of a computer system, e.g., ELHILL.

TIME SHARING: Term used for a computer system that allows a number of users to execute programs at the same time, with the system servicing them in such rapid sequence that the users appear to be handled simultaneously.

TIME SLICE: A segment of time on the central processing unit allocated for use in performing a particular job. Once the interval has been used up, CPU time is allocated to another job.

UPDATE: To modify a file with current information according to a specified procedure.

USER ENVIRONMENT (Work Space): That area in computer memory and disk that is used to store the search formulation for each user and the created lists of citations that are the results of the user's searches. There is a finite amount of space reserved for each user.

Appendix E

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BIBLIOGRAPHIC SEARCH REQUEST

[INSTITUTION NAME/ADDRESS]

Name: _____ Date: _____

Mailing Address: _____ Phone: _____

City: _____ State: _____ Zip: _____

DETAILED STATEMENT OF QUESTION: Please describe in your own words the subject matter for which the search is to be conducted. Please be as specific as possible. Define any terms which may have special meanings in your statement. Also, if there are points *not* to be included, please state these.

INDICATE PREFERENCE:

( ) Few, very relevant articles
( ) Comprehensive search

TO BE USED FOR:

( ) Patient Care ( ) Lecture
( ) Research ( ) Grant Application
( ) Other

SEARCH SPECIFICATIONS:

_____ Human
_____ Female only
_____ Male only

_____ Animal experiments (if only certain animal groups are of interest, please list them)

AGE GROUPS:

_____ All _____ Specific ages (list)

LANGUAGES:

_____ Will accept articles in all languages
_____ Will accept articles in the ENGLISH language ONLY
_____ Will accept articles in the ENGLISH language or FORIEGN language articles which have ENGLISH language abstracts
_____ Will accept only certain languages (please specify)

KNOWN RELEVANT PAPERS:

Please list any known relevant papers from the last three years.